

MORPHOLOGICAL, CHEMICAL AND INDUMENTUM CHARACTERISTICS OF *RHODODENDRON LUTEUM* SWEET (ERICACEAE)

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Abstract

This report concerns morphological, chemical and indumentum characteristics of *Rhododendron luteum* Sweet collected from Ordu province. A detailed description of the species has been prepared and compared with that published in the Flora of Turkey of Davis in a tabular form. The description is supported by drawings and original photographs. Chemical composition of the head space odour of the plant material was elucidated. Indumentum characteristics were investigated and their SEM photographs were taken.

R. luteum is a deciduous plant growing up to 3-4 m, in North and Eastern Anatolian mountains. It is a poisonous plant known as “Zifin, Sifin, Cifin, Sarı ormangülü, Eğri çiçeği, Sarı ağrı”. Leaves ovate-lanceolate, strigose glandular hairs on both surfaces. Flowers are yellow, main odour components were found as β -caryophyllene (34.0%), methyl benzoate (11.7%), (E)- β -ocimene (10.4%) and α -pinene (10.0%).

Introduction

Rhododendron L. (Ericaceae) comprises woody, evergreen shrubs. It is spread in the Northern hemisphere especially in temperate regions of North America, Europe and Asia with over 850 species. In Turkey, it is distributed in the North, especially in Eastern Black Sea coastal areas. The genus is represented by 10 taxa including 5 species, 4 hybrids and 1 form. One species is endemic. These are *R. luteum* Sweet (Sarı çiçekli ormangülü), *R. unguernii* Trautv. (Ak Ormangülü), *R. smirnowii* Trautv. (Kızıl Kumar) end., *R. caucasicum* Pallas (Kafkas Ormangülü), *R. ponticum* L. subsp. *ponticum* (Mor Çiçekli Ormangülü), *R. ponticum* subsp. *ponticum* forma *album*, *R. x sochadzeae* Charadze & Davlianidze, *R. x rosifaciens* R. Milne, *R. x davisianum* R. Milne, *R. x filidactylis* R. Milne (Avcı, 2004; Güner *et al.*, 2000; Stevens, 1978 and Terzioğlu *et al.*, 2001).

R. luteum and *R. ponticum* contain a poisonous principle, andromedotoxin, in their leaves and flowers. Sheep and goats fed on their young shoots or flowers are poisoned. A honey made up of their flowers is poisonous due to andromedotoxin. This honey which is locally known as mad honey (deli bal) has hypotensive properties. When consumed, man shows consciousness disorders similar to drunkenness are observed. Over dose is lethal. Leaves of *R. luteum* (Kumar leaf) contain tannin, essential oil, erikolin, arbutin and andromedol derivatives. Although used as diuretic and analgesic in rheumatic pains its infusion can be dangerous due to andromedol derivatives. A decoction of *R. luteum* and *R. ponticum* leaves is externally used to treat fungal foot infections in Giresun province (Dereli, Çalca Eğriambar). *R. luteum* is also used as ornamental due to its showy flowers (Baytop, 1984, Baytop, 1991; Zeybek and Zeybek, 1994 and Acartürk, 1997; Tuzlacı, 2006).

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Here, we report our findings on morphological, morphometric, chemical properties and indumentum characteristics of *R. luteum* collected from Ordu province. Headspace volatiles trapped by HS-SPME were analysed by gas chromatography/mass spectrometry (GC/MS). There is only one study on the chemistry of *R. luteum* (Taşdemir 2003). Indumentum characteristics of *R. luteum* were investigated and SEM photographs were taken.

Materials and Methods

Plant material: Aerial parts were collected in June 2007 at Ordu: Fatsa, Aybastı, Perşembe yaylası at an altitude of 1600 m. Voucher specimens are kept at the Herbarium of the Faculty of Pharmacy, Anadolu University in Eskişehir, Turkey (ESSE 14428).

Morphological and anatomical features: The materials were identified as *R. luteum* using the Flora of Turkey and the East Aegean Islands (Stevens, 1978). Herbarium specimens were used for description and detailed morphological drawings. A Leitz SM-LUX binocular microscope with drawing tube was used for anatomical drawings. A wild M5 A stereo microscope with drawing tube was utilized for morphological drawing.

Scanning electron microscope (SEM): Indumentum of stem, leaves and flowers were investigated by mounting in double sided sticky carbon band and coated with gold. Photographs were taken using Cam Scan S4 scanning electron microscope.

Headspace-solid phase micro extraction (HS-SPME) analysis: 60 min. sampling was carried out on live plant materials using a blue fibre Polydimethylsiloxane-Divinylbenzene (PDMS/DVB-65µm) – Blue (supplied by Supelco Bellefonte, USA). The fibre was directly desorbed in GC/MS for 10 min.

Headspace-SPME procedure: The volatiles were trapped by SPME in a dynamic headspace set up. The fibres used in this study were coated with Polydimethylsiloxane-Divinylbenzene (PDMS/DVB-65µm) – Blue (supplied by Supelco Bellefonte, USA), was used with a sampling time of 60 min. Thermal desorption at 250°C during 10 min.

GC/MS conditions: GC/MS: The GC/MS analysis was carried out with an Agilent 5975 GC-MSD system. Innowax FSC column (60m x 0.25mm, 0.25µm film thickness) was used with helium as carrier gas (0.8 mL/min.). GC oven temperature was kept at 60°C for 10 min and programmed to 220°C at a rate of 4°C/min, and kept constant at 220°C for 10 min and then programmed to 240°C at a rate of 1°C/min., at splitless mode. The injector temperature was at 250°C. MS were taken at 70 eV. Mass range was from m/z 35 to 450.

The components of essential oils were characterized by comparison of their mass spectra with those in the Baser Library of Essential Oil Constituents, Wiley GC/MS Library, Adams Library, MassFinder Library and confirmed by comparison of their retention indices. Alkanes were used as reference points in the calculation of relative retention indices (RRI). The results of analysis are shown in Table 3.

Table 1. Morphological and morphometrical characters of *Rhododendron luteum* (Figure 1).

Morphological and morphometrical characters		Flora of Turkey	The findings of this study
Plant		Suckering, deciduous shrub	Suckering, deciduous shrub
Plant size		4 m	4 m
Terminal bud		1.5 cm	1-2 cm
Petiole		0.2-0.5 cm	0.1-0.7 cm
	size	4-8.5x1.8-2.5 cm	1.5-8.5x1-2.5 cm
	shape	Ovate- oblanceolate	Ovate- oblanceolate
Lamina	base	--	Acute
	margin	--	Repant-integer
	apex	--	Obtus
	Number of flowers	5-15	5-20
Inflorescence	shape	--	Terminal
	axis	1-2 cm	1-3.5 cm
Pedicel	size	1.8-2.4 cm	0.5-2.5 cm
Bracts	shape	--, deciduous	Ovate-linear, deciduous
	size	c.1.5 cm	1.2-1.5 cm
	Shape of lobes	--	Ovate-linear
Calyx	Number of lobes	--	5
	Size of lobes	1.5-8.5 mm	1-10 mm
	colour	Yellow	Yellow
	shape	Infundibular	Infundibular
	acros	3.8-4.5 cm	3.5-5 cm
	size	--	3-4 cm
Corolla	Shape of lobes	--	Oblong-ovate
	Number of lobes	--	5
	Size of lobes	1.5-2 cm	1.5-2.5 cm
	Size of tube	c. 1.5 cm	1.5 cm
	number	5	5
Stamen	size	--	25-45 mm
	shape	--	Dorsifixed
Anther	colour	--	White
	size	--	2-2.5 mm
	size	--	23-43 mm
Filament	colour	--	White at apex, base brown
	size	--	4-5x1.5-2 mm
Ovary	shape	--	Oblong-cylindric, 5-locular
	size	4-5.5 cm	1.5-6 cm
Style	colour	--	Pale brown
	shape	--	Capitate
Stigma	colour	--	Pale brown
	shape	--	Ovate-cylindric
Capsule	size	1.7-2.2 cm	1-2.2 cm
	size	c. 3 mm	7 mm
Seeds	colour	---	Pale brown



Fig. 1. *Rhododendron luteum*. a-- plant; b-- leaves; c-- bracts; d₁-- flower (front view); d₂-- flower (side view); e-- pistil; f-- stamen; g-- capsule; h-- nutlets.

Table 2. Indumentum characters of *Rhododendron luteum*.

	Flora of Turkey	The findings of this study
Stem	Glandular	Glandular-strigose pilose
Leaves	Glandular or strigose	Glandular-strigose pilose
Pedicel	Glandular	Glandular-pubescent
Bracts	-----	Glabrose, pubescent at apex
Calyx	-----	Glandular-densely pubescent
Corolla	Glandular-pubescent outside	Glandular-pubescent outside
Filament	-----	Pubescent near base
Ovary	Glandular-strigose	Glandular- densely pubescent
Style	Pubescent near base	Glabrose

Results and Discussion

To the best of on knowledge, there in no morphological study on *R. luteum*. Morphological and morphometric descriptions are compared with those in Flora of Turkey in Table 1. Most of over findings were in agreement with those features published in the Flora of Turkey. However, lower limits of leaf, pedicel, style and fruit dimensions were found to be higher in our findings. This is possibly due to the number of specimens investigated and to ecological reasons. Here we also report for the first time the base, margin, shape of lamina, type of inflorescence, calyx tooth shape and number, corolla length, shape and number of lobes, stamen length, shape colour and length of anther, colour and length of filament, ovary size and shape, style colour, stigma shape and colour, seed colour characteristics were also looked at.

Indumentum characteristics of stem, leaf, pedicel calyx, corolla, ovary and style were investigated by anatomical studies and SEM photographs in comparison with those given in the Flora of Turkey in Table 2. Covering trichomes are simple with 1-8 cells; glandular hairs emergence. Indumentum characters deviated from those reported by Davis, 19 _____. In addition to those character published in Flora of Turkey, we also observed pilose trichomes on the stem and pubescent trichomes on the pedicel. Covering trichomes on the leaves are pilose. Bracts are pubescent on the apex, calyx and ovary are pubescent. Style is glabrous (Figs. 2 and 3).

Headspace volatiles of fresh flowers of *Rhododendron luteum* Sweet (*Ericaceae*) was analyzed by gas chromatography/ mass spectrometry. The volatiles were trapped by SPME in a dynamic headspace set up. *Rhododenrron* flowers blue - Polydimethylsiloxane/ Divinylbenzene (PDMS/DVB) fibre was used. 34 compounds were characterized representing 96.5% of the volatiles. β -Caryophyllene (34.0%), methyl benzoate (11.7 %), (*E*)- β -ocimene (10.4%) and α -pinene (10.0%) were found as main components.

In previous studies, extract of leaf and flowers were reported from *R. luteum*. Extract of the leaves was investigated, ethyl acetate (13.3%), 6- methyl-5 hepten-2-one (11.1%) (in hexane extract), and butanol (58.7%), benzyl alcohol (17.1%) (in chloroform extract). Extract of the flowers was investigated, benzyl alcohol (16.6%), limonene (14.6%) and p-cymene (8.4%) were found as main components (Taşdemir *et al.*, 2003). This is the first report on the headspace volatiles of these plant.

Table 3. Composition of the essential oil of *Rhododendron luteum*.

RRI	Compounds	%
1032	α-Pinene	10.0
1118	β -Pinene	2.4
1159	δ -3-Carene	0.2
1246	(Z)- β -Ocimene	0.7
1257	(E)-β-Ocimene	10.4
1266	3-Octanone	0.3
1353	Hexyl isobutyrate	0.2
1360	Hexanol	0.7
1400	Nonanal	0.2
1412	(E)-2-Hexenol	1.0
1438	Hexyl 2-methyl butyrate	0.3
1452	1-Octen-3-ol	0.2
1479	δ -Elemene	2.2
1483	Octyl acetate	2.3
1496	2-Ethyl hexanol	0.5
1503	Isomenthone	0.2
1541	Benzaldehyde	0.5
1544	α -Gurjunene	1.6
1553	Linalool	0.4
1590	Bornyl acetate	0.5
1600	β -Elemene	1.5
1612	β-Caryophyllene	34.0
1641	Methyl benzoate	11.7
1661	Alloaromadendrene	0.7
1687	α -Humulene	1.5
1706	α -Terpineol	0.7
1726	Germacrene D	0.6
1740	α -Muurolene	0.3
1758	(E,E)- α -Farnesene	0.9
1773	δ -Cadinene	0.9
1896	Benzyl alcohol	2.1
2030	Methyl eugenol	1.6
2200	trans- Methyl isoeugenol	3.4
2607	Octadecanol	1.8

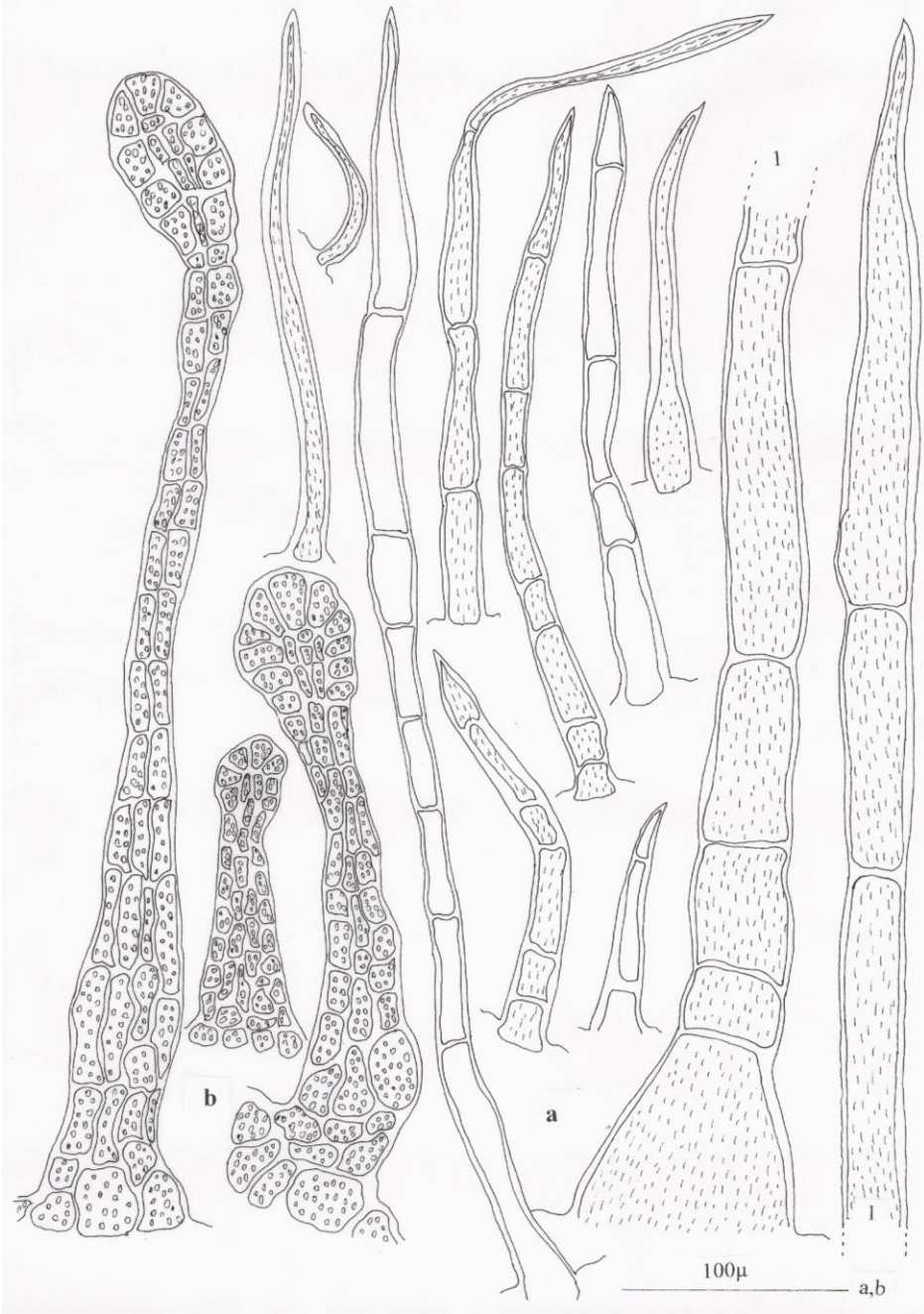


Fig. 2. In light microscope of hairs of *Rhododendron luteum*. a-- covering hairs; b-- glandular hairs (emergence).

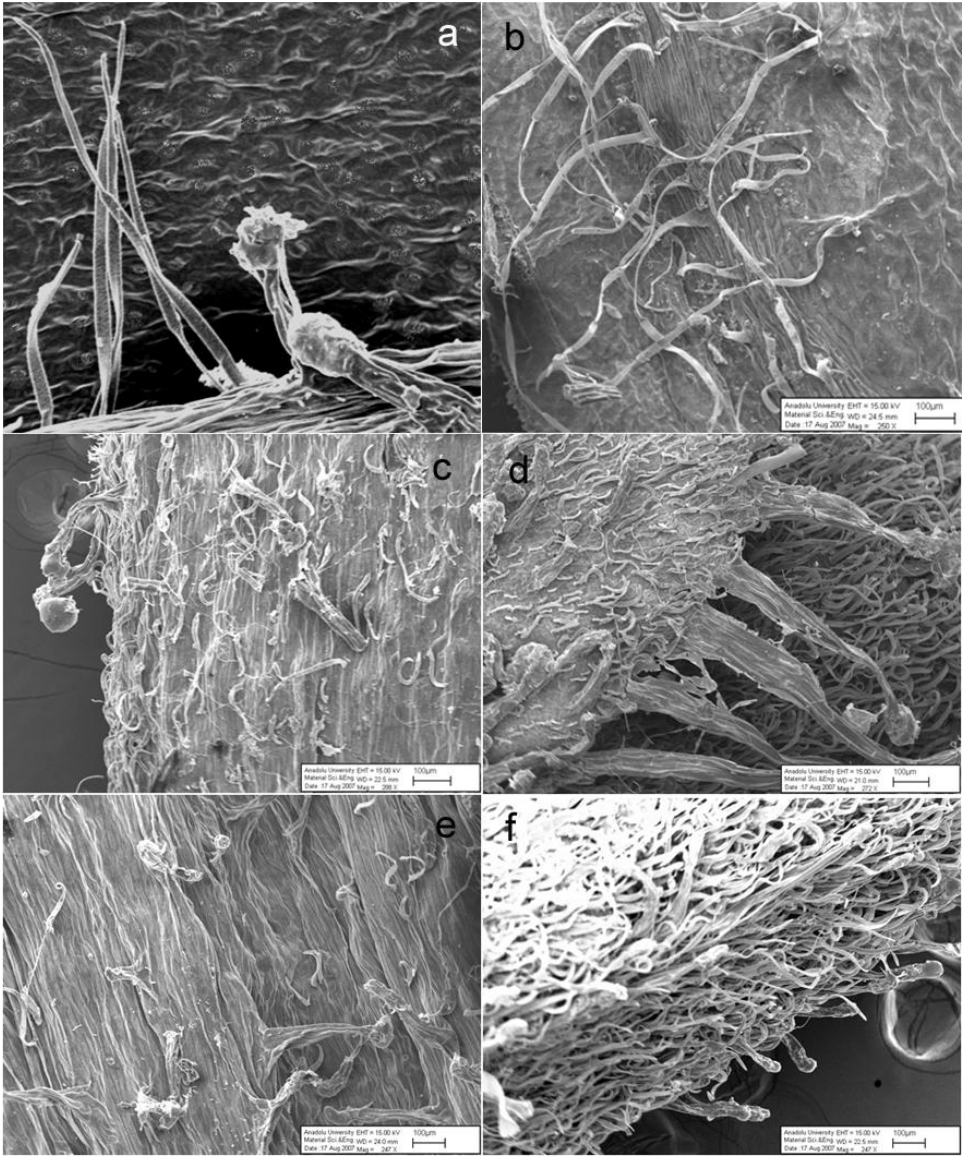


Fig. 3. SEM photographs of hairs of *Rhododendron luteum*. a-- stem; b-- abaxial surface of the leaf; c-- pedicel; d-- outer surface of the calyx; e-- outer surface of the corolla; f-- ovary.

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(Received for publication 3 December 2009)